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AQUATIC PLANTS

A Guide For Their Identification And Control in Pennsylvania

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A Publication of the Water Resources Coordinating Committee
Commonwealth of Pennsylvania

AQUATIC PLANTS

A GUIDE FOR THEIR
IDENTIFICATION
AND
CONTROL
IN
PENNSYLVANIA

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Member Agencies

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Department of Commerce
Department of Community Affairs
Department of Environmental Resources
Department of Transportation
Fish Commission
Game Commission
Public Utility Commission
State Planning Board

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COMMONWEALTH OF PENNSYLVANIA
Milton J. Shapp, *Governor*

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Foreword

This manual provides guidelines for proper methods used in the control of nuisance aquatic vegetation.

The various aquatic herbicides mentioned in this manual conform with the Federal Insecticide, Fungicide and Rodenticide Act for use in aquatic habitats.

The current list of suggested herbicides (page 54) is subject to periodic revision.

Chemicals listed in this manual are not necessarily endorsed by the Commonwealth of Pennsylvania, nor does the Commonwealth assume any responsibility for their use. This listing is intended solely as a convenience for those who may desire a source for obtaining the products used in aquatic vegetation control.

To apply for a permit to use an algacide, herbicide or fish control chemical, the applicant must submit an Application Form, properly completed, *signed* and attested to the Benner Spring Fish Research Station, R.D. #1, Box 200-C, Bellefonte, Pennsylvania 16823. Sample form and instruction sheet are shown on pages 59, 60, 61 & 62. These forms may be obtained from the following agencies:

1. Regional Offices of the Pennsylvania Fish Commission or Pennsylvania Department of Environmental Resources.
2. Fish Commission County waterways patrolmen.
3. Pennsylvania Department of Agriculture district offices.
4. County Agricultural Extension Agent offices.
5. Pennsylvania State Soil and Water Conservation district offices.
6. District Forester offices.
7. U.S.D.A., Soil Conservation Service county offices.

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I. Introduction

A. Purpose and Scope

All but the most sterile waters have some aquatic weeds. This, then, is a natural condition, and when plants are present in modest amounts they beautify the lake. On the other hand, a lake with no apparent plant life along its edges is unattractive and unproductive.

Modest stands of aquatic plants in lakes and ponds are beneficial to the fishes since they: (1) provide hiding places for adult fishes (and hence good fishing spots); (2) serve as refuge for juvenile fishes; and (3) harbor many insects eaten by fishes.

The degree of weed control should be determined by the type recreation or other use desired. For example, weeds should be completely eradicated from a swimming beach and lanes should be opened for boats. For fishery purposes, some weed beds are desirable in strategic places.

The use of special chemical preparations for the control and elimination of nuisance growths of aquatic plants is increasing. New chemicals are continually being developed and marketed under a variety of scientific and commercial names. Use of these chemical agents requires knowledge of specific methods of application and the identity of the aquatic plants to be controlled or eliminated. Many of the chemicals are effective in the control of certain aquatic plants but may not affect others. In some instances it may be necessary to apply more than one chemical to the same body of water. To achieve maximum effect, certain chemicals must be applied when plants are in the very early stages of growth. Others must be applied during the active growing season and there are those which are only effective after the plants are fully mature. The hardness and temperature of the water to be treated are also important factors to be considered.

Improper or careless application of chemicals can be a health hazard. Some chemicals are extremely toxic to man and animals. Care must be taken to avoid the breathing of dust from dry chemicals and the mist from spraying chemicals in solution. Direct contact with the skin can be equally hazardous.

The dosage rate must be carefully calculated for each type of chemical, size of the water body and type of plants to be controlled. There are certain legal restrictions imposed by the Commonwealth where the use of aquatic herbicides may endanger fishes or other aquatic animal life and where public drinking water supply or public swimming areas may be contaminated.

This manual contains information for the proper use of those aquatic herbicides presently used in Pennsylvania. Its purpose is to provide a guide to determine suitable control methods, calculations of dosage rates, and time of treatment. It provides a means of identifying the most common aquatic plants in Pennsylvania and lists the chemicals appropriate for their control and precautions to be followed to avoid hazardous use.

B. Factors Influencing Excessive Growth of Aquatic Plants

All aquatic plants require sunlight and nutrients for growth. In a natural aquatic environment the most important nutrients, such as phosphorus and nitrogen, are leached from the earth's crust, or are liberated through the decomposition of organic materials. These nutrients enter water courses through runoff of surface waters, or through ground waters, and become available for use by aquatic plants. In a natural aquatic environment, these nutrients are usually found in extremely limited amounts with a resulting limited amount of aquatic vegetation.

Aquatic weed problems have increased markedly over the past several decades due to man's increased domestic, industrial and agricultural activities.

The most significant contributor of excessive nutrients is human sewage. Sewage, even "treated" sewage is rich in the two basic nutrients, phosphorus and nitrogen. Drainage from septic tanks and privies, discharge of treated municipal sewage, or runoff from barnyards and feedlots will all eventually find their way either by surface runoff or in the ground water to lakes, ponds, or streams. The nutrients present in these wastes will eventually result in the production of more and more aquatic weeds.

Industry can also be a significant contributor of nutrients. Detergents, which contain high phosphate concentrations are used widely as cleaning compounds in most industries. Nutrient materials can also be generated as by-products of many industrial processes.

The increasing use of fertilizers (high in phosphorus and nitrogen) in agricultural practices has significantly increased the nutrient concentration in waters due to heavy surface runoff and ground water seepage. These excess nutrients cause increased production of aquatic plants, which can turn a once highly desirable aquatic environment into one choked with weeds.

Other less important factors which are conducive to excessive growth of aquatic weeds and algae are: (1) shallow depths; (2) high water temperatures; (3) lack of precipitation.

Now that we know what and, more exactly, who causes the problem, what preventive measures can and must be taken to bring it under control? Probably, the first and most obvious measure is to stop discharging improperly treated wastes into our waters. Satisfactory methods of removing the nutrient contents from these wastes are now available and should be implemented.

In the planning, design, and location of impoundments, consideration should be given to the possible sources of contaminants from within the watershed area.

While contemplating the most desirable recourse to follow, perhaps the only immediate alternative is to employ one or more of the current methods stated in this pamphlet for aquatic vegetation control.

II. Control Methods

A. Mechanical Controls

1. Physical Removal—This type of control involves cutting, pulling, mowing, raking or skimming. It is most effective for small quantities of plants near the shoreline or in small ponds. Exceptions to this include the use of special cutting machines which are capable of removing weeds from large areas.

   There are two important things to consider with the use of mechanical methods. It is most important to remove cut weeds from the immediate drainage area of a lake, pond or stream so that nutrients released during decomposition will not re-enter the water area. Such enrichment, if permitted, could promote new and increased weed growth.

   The other important thing to remember is that most mechanical methods are temporary and have to be repeated frequently —much like mowing a lawn. The cutting methods that cause fragmentation of many of the underwater types of plants, such a milfoil, elodea, and coontail, actually can cause spreading. This happens because each plant fragment left in the water can become a new plant.

   Plants that can be removed by digging, cutting or pulling include sedges, reeds, cattails, water lilies and spatterdock. As mentioned above, such treatment usually has to be repeated a number of times. Floating algae and duckweed can be removed temporarily by dragging a floating plank or net across the top of the pond.

   The special cutting machines available include those that cut swaths four or more feet in width and several feet deep. However, it is hard to remove the cut vegetation. Some of the most highly developed machines will cut and remove the aquatic vegetation in one operation. Most of the submerged types of weeds can be cut by this method.

2. Dredging to increase depth—Very shallow ponds or lakes can be dredged to depths of 10 feet or more in problem areas. Submerged vegetation does not, normally, become a problem at such depths since sunlight penetration is usually not sufficient to stimulate excessive growth. This is a very expensive method of control which could be eliminated by proper planning before the pond is constructed.

3. MISCELLANEOUS METHODS—Other methods that can be used in special situations to control aquatic vegetation include:
   a. Lining the pond bottom with black plastic sheeting material. This, in effect, shuts out light and prevents the growth of most of the attached or rooted aquatic vegetation. Sheets should be placed in the pond at the early part of the growing season. This method does not control algae or duckweed.
   b. Lowering water levels. Some aquatic plants, such as milfoil, can be controlled if the pond is partially drained in late autumn to allow the edges to freeze. To be effective, bottom mud should freeze to a minimum depth of 4 inches for 3 weeks or longer.

B. CHEMICAL CONTROLS

1. INTRODUCTION—The use of special chemicals, called herbicides, for aquatic vegetation control has increased markedly in recent years. Chemical herbicides kill the aquatic weeds either by direct contact or by disrupting normal growth processes resulting in extremely accelerated growth. Although chemical control is the most practical, effective, and specialized method available, unsuccessful weed control programs and excessive fish mortalities can result from errors in judgment, calculation and methods of application. It is, therefore, extremely important that the user *FOLLOW THE MANUFACTURER'S DIRECTIONS AND NEVER EXCEED THE RECOMMENDED DOSAGE.* Most herbicides are safe for humans and aquatic life if dosages and application rates are observed. It should be emphasized that, since the waters in various lakes, ponds and streams throughout Pennsylvania vary considerably in their physical and chemical composition, it is not possible to predict with total accuracy that a given herbicide will effectively control a specific plant in a particular body of water.

2. PRECAUTIONS AND HAZARDS—Anyone using chemical herbicides should use *EXTREME CAUTION AND FOLLOW THE DIRECTIONS ON THE MANUFACTURER'S LABEL. SOME OF THE AQUATIC HERBICIDES ARE EXTREMELY TOXIC TO HUMANS, LIVESTOCK, AND AQUATIC LIFE. EXCEEDING THE RECOMMENDED DOSAGES MUST BE AVOIDED AT ALL TIMES.*

   Most herbicides are toxic if taken internally, and direct contact with the chemical should be avoided. *USE CAUTION AND COMMON SENSE.* Rubber gloves, boots and other protective clothing should be employed when applying the chemical.

AVOID DIRECT CONTACT WITH THE SKIN. If it comes in contact with the skin, wash the affected areas immediately with water.

All equipment used in spraying operations should be washed immediately to prevent corrosion of metal containers. Any spray unit used for 2,4-D should be rinsed with a solution of ammonia or washing soda before reuse.

Water treated with chemical herbicides should not be used for livestock watering, irrigation, or human consumption for a period of time as specified on the manufacturer's label. This time period will vary with the specific herbicide used.

Most fishes and other aquatic life can tolerate the dosage levels needed to kill aquatic weeds. Minor fish kills can result when herbicide chemicals are not evenly distributed in limited areas. Fish mortality can also result if large areas to be treated are sprayed at one time. A rapid kill of aquatic plants may cause oxygen depletion, resulting from a high rate of decomposition. For these reasons, when a large area is to be treated, smaller segments should be treated individually with *at least* a one week interval between treatments, until the entire area has been treated. Many herbicides used for aquatic vegetation control cannot be used in public drinking water supply reservoirs.

3. When should treatment be carried out?—Most aquatic weeds should be treated in early spring when growth is rapid, but before seeding takes place. In Pennsylvania, all treatment, with the exception of filamentous algae, plankton algae and duckweed should be completed before June 30. Most herbicides are less effective after seeding has taken place. Where excessive aquatic plant production is evident, several successive monthly treatments may be necessary throughout the growing season. Yearly treatments may be required since aquatic weeds, like terrestrial weeds, occur annually and mature seeds are not killed by the herbicide. In relation to filamentous and plankton algae, and duckweed, treatment may have to be conducted throughout the growing season (spring, summer, fall) for effective control.

   It is more practical to treat only those shoreline areas and bays on large lakes and ponds that are being used for recreational purposes while small ponds may be treated completely.

4. Methods of application—Small bodies of water such as farm ponds or small lake shore areas can be treated with liquid herbicides by means of a small, 3 to 5 gallon, pressure-type hand or back-pack sprayer, available at most garden centers, farm

supply stores, or hardware stores. For very small ponds, ingredients may be mixed in a tub and applied with a dipper.

For larger bodies of water of more than 5 acres, such as lakes, reservoirs, or large ponds, heavier commercial-type spray equipment is needed. A motorized pump adapted with a "T" intake can be employed in which lake water and the liquid herbicide are mixed and pumped continuously. Tractor or other farm sprayers can also be employed.

An extremely effective and easy method employs the use of a common boat bailer. The bailer is attached to the motor directly above the propeller and connected to a drum containing the herbicide. As the boat moves through the water, the chemical is drawn into the water and mixed by the prop wash.

For applying granule formulations of herbicides in relatively small areas, such as farm ponds or around boat docks, the material can be applied by hand, or more effectively, by means of a hand-operated, crank-type fertilizer or seed spreader. If larger areas are to be treated, large-scale commercial granule applicators which are capable of dispersing granules in a 30 to 35 foot swath and powered by a small electric motor should be employed. Helicopters and fixed-wing aircraft are also very effective as a means of applying granules in large-scale operations.

Whichever method is employed, it is essential that the herbicidal chemical be evenly distributed throughout the water being treated. It is also important, especially in treating submerged aquatic weeds, that enough chemical reaches the deepest portions of the body of water so that maximum efficiency results.

In reservoirs, lakes and ponds which have a high rate of flow-through, it is desirable to draw down the water level prior to treatment to insure adequate contact time for the herbicide. Three to five days should be allowed after the initial treatment before water is permitted to overflow the spillway.

5. CALCULATIONS FOR DETERMINING THE AREA TO BE TREATED—To calculate the amount of chemical to be used, it is necessary to first determine the volume of water in the pond, lake, or reservoir expressed as *acre-feet*. The number of *acre-feet* can be determined by multiplying the surface area (in acres) by the average depth (in feet).

> *For example:* A pond that has 2 surface acres of water and an average depth of 5 feet contains 10 acre-feet of water.
>
> 2 acres x 5 feet=10 acre-feet

The number of surface acres of an area can be determined by multiplying the average length (in feet) by the average width (in feet) of the body of water and dividing by 43,560 (since 43,560 square feet = 1 acre).

For example: A pond that is 501 feet in length and 174 feet in width has a surface area of approximately 2 acres.

$$\frac{501 \text{ feet x } 174 \text{ feet}}{43{,}560 \text{ sq. feet}} = 2 \text{ surface acres}$$

The average depth of a body of water is estimated by taking one-half of the maximum depth. If the maximum depth of a pond is 10 feet, then the average depth can be approximated by taking one-half of 10 feet, or 5 feet. However, as shown in the following example, a second method is more accurate and should be employed. This involves taking a number of depth measurements across the length and width of the pond with a weighted rope marked off in feet. These measurements are totaled and then divided by the total number of depth measurements made to obtain the average depth in feet.

For example: If the following series of depth measurements were made along the length and width of the pond, then the average depth would be computed as follows:

Depths along Length	*Depths along Width*
4′	1′
6′	4′
10′	6′
8′	6′
5′	4′
33′	21′

$$\text{Then: } \frac{33' + 21'}{10 \text{ measurements}} = 5.4 \text{ feet}$$

6. CALCULATIONS FOR DETERMINING DOSAGE—Most commercial herbicides contain a relatively small portion of active ingredient which is the effective controlling agent. In most instances, the recommended dosage is based on the percentage of active ingredient which must be known to calculate the application rate, and before one can compare the cost of one herbicide with

another. The *liquid* herbicides are expressed as *pounds* of active ingredient per gallon of liquid and the *granular* herbicides as *percent* of active ingredient. The herbicides described in this bulletin are listed on page 54, by the trade name, chemical name, amount of active ingredient and estimated cost.

Once the acre-feet of water has been calculated, this figure is multiplied by the recommended dosage (in pounds or gallons) to obtain the total amount of herbicide required in parts per million (ppm). Since an acre-foot of water weighs 2.7 million pounds, then a concentration of 1 part per million of herbicide can be obtained by dissolving 2.7 pounds (or equivalent weight of active ingredient based on gallons) of herbicide per acre-foot of water.

Acre-feet of water times recommended ppm times 2.7 million pounds equals No. of pounds of herbicide per total No. of acre-feet to be treated.

Example 1: If a desired concentration of 0.5 ppm of copper sulfate (100% active) is required to treat a pond with 10 acre-feet of water, then the number of pounds of copper sulfate needed is:

10 acre-feet x 0.5 ppm x 2.7 million pounds =
13.5 lbs. of Copper Sulfate per 10 acre-feet

Where the percent active ingredient is less than 100, the dosage rate can be calculated as follows:

$$\frac{\text{No. of acre-feet of water x recommended ppm x 2.7 million pounds}}{\text{pounds active ingredient}} = \text{No. of lbs. of herbicide per total No. of acre-feet to be treated}$$

Example 2: If a desired concentration of 0.5 ppm of Aqua-Vex (6 lbs. acid per gallon) is required to treat a pond with 10 acre-feet of water, then the number of gallons of Aqua-Vex needed is:

$$\frac{\text{10 acre-feet x 0.5 ppm x 2.7 million pounds}}{\text{6.0 lbs. acid}} = \text{2.25 gallons of Aqua-Vex per 10 acre-feet}$$

C. BIOLOGICAL CONTROLS

The use of chemicals for aquatic vegetation control, while probably the most effective treatment known at this time, leaves much to be desired. It is never advisable to promote the widespread use of chemical materials which not only produce immediate effects, but may also be manifested in some part of the aquatic community through a delayed toxic reaction. As with the control of land pests, it is often much more desirable to use some kind of biological method. Unfortunately there is no good universal biological method known at this time. However, this area is receiving attention and the effective biological control of aquatic vegetation is within the realm of possibility and should be encouraged.

Some methods of Biological Control are listed below.

1. FERTILIZATION—This is a method used successfully in the South for aquatic weed control and increased fish production. Results in the North have not been especially successful, at least for weed control. Briefly it requires adding commercial or animal fertilizer to a pond during warm weather to produce a "bloom" of millions of minute plants and animals. This bloom causes a turbid appearance in the water which tends to shade out the submerged higher plants. Often in the North the bloom fails to develop properly and the weeds for which control is desired are actually stimulated into heavier growth.

2. THE USE OF PLANT EATING ANIMALS
    a. *Fish*—The use of weed-eating fish has been successful in some tropical climates. The grass carp, *Ctenopharyngodon idella,* has been used successfully in some temperate climates and is being used experimentally in the USA. The common carp and a few other species can control algae as well as higher plants under some situations. It is never advisable, however, to introduce exotic fish species unless the potential harm from such introductions is considered.
    b. *Invertebrates*—Some invertebrates such as crayfish have been used for aquatic vegetation control. Recently in New Mexico a species of crayfish, *Orconectes causeyi,* has shown exceptional ability to control aquatic vegetation in trout ponds.
    c. *Higher animals*—Ducks and geese will control aquatic weeds in some instances. The *Nutria,* a muskrat-like animal, has given good results in the hard water ponds of Israel, but has caused much damage in southern U. S. and is now considered an undesirable pest. The State of Florida has been experimenting with the use of seacows for the control of the water hyacinth. Here again, the potential harm from such animal introductions should be considered.

3. PLANT DISEASES—Little is currently known about this method of control, but it appears to have a great potential. By introducing a disease such as a bacterial or fungus infection a specific aquatic nuisance plant might be controlled with no harm to any other aquatic life.

III. Laws and Regulations

Pertaining to the Use of Herbicides in Pennsylvania

A. THE CLEAN STREAMS LAW OF PENNSYLVANIA

ARTICLE IV—OTHER POLLUTIONS AND POTENTIAL POLLUTION

SECTION 401. *Prohibition Against Other Pollutions*

It shall be unlawful for any person or municipality to put or place into any of the waters of the Commonwealth, or allow or permit to be discharged from property owned or occupied by such person or municipality into any of the waters of the Commonwealth, any substance of any kind or character resulting in pollution as herein defined. Any such discharge is hereby declared to be a nuisance.

SECTION 402. *Potential Pollution*

(a) Whenever the board finds that any activity, not otherwise requiring a permit under this act, including but not limited to the impounding, handling, storage, transportation, processing or disposing of materials or substances, creates a danger of pollution of the waters of the Commonwealth or that regulation of the activity is necessary to avoid such pollution, the board may, by rule or regulation, require that such activity be conducted only pursuant to a permit issued by the department or may otherwise establish the conditions under which such activity shall be conducted, or the board may issue an order to a person or municipality regulating a particular activity. Rules and regulations adopted by the board pursuant to this section shall give the persons or municipalities affected a reasonable period of time to apply for and obtain any permits required by such rules and regulations.

(b) Whenever a permit is required by rules and regulations issued pursuant to this section, it shall be unlawful for a person or municipality to conduct the activity regulated except pursuant to a permit issued by the department. Conducting such activity without a permit, or contrary to the terms or conditions of a permit or conducting an activity contrary to the rules and regulations of the board or conducting an activity contrary to an order issued by the department, is hereby declared to be a nuisance.

Section 602. *Penalties*

(a) Any person or municipality who violates any provision of this act or any rule or regulation or order of the board or any order of the department issued pursuant to this act is guilty of a summary offense and, upon conviction, shall be subject to a fine of not less than one hundred dollars ($100) nor more than one thousand dollars ($1,000) for each separate offense, and, in default of the payment of such fine, the person, or if such person be a partnership, then the members thereof, or if such person be a corporation or association, then the officers, members, agents, servants or employes thereof, shall be imprisoned in the county jail for a period of sixty days.

(b) Any person or municipality who, after a conviction in a summary proceeding within two years as above provided, violates any provision of this act or any rule or regulation or order of the board or any order of the department issued pursuant to this act is guilty of a misdemeanor and, upon conviction, shall be subject to a fine of not less than one hundred dollars ($100) nor more than five thousand dollars ($5,000) for each separate offense or to imprisonment in the county jail for a period of not more than one year, or both. In the case of a partnership the members thereof, and in the case of a corporation or an association the officers, members, agents, servants or employes thereof, may be subject to any such sentence of imprisonment.

(c) Each day of continued violation of any provision of this act or any rule or regulation or order of the board or any order of the department issued pursuant to this act shall constitute a separate offense under subsections (a) and (b) of this section.

Section 605. *Civil Penalties*

In addition to proceeding under any other remedy available at law or in equity for a violation of a provision of this act or a rule or regulation of the board or an order of the department, the board, after hearing, may assess a civil penalty upon a person or municipality for such violation. Such a penalty may be assessed whether or not the violation was wilful. The civil penalty so assessed shall not exceed ten thousand dollars ($10,000), plus five hundred dollars ($500) for each day of continued violation. In determining the amount of the civil penalty the board shall consider the wilfullness of the violation, damage or injury to the waters of the Commonwealth or their uses, cost of restoration, and other relevant factors. It shall be payable to the Commonwealth of Pennsylvania and shall be collectible in any manner provided at law for the collection of debts. If any person liable to pay any such penalty neglects or refuses to pay the same after demand, the amount, together with interest and any costs that may accrue, shall be a lien in favor of the Commonwealth upon the property, both real and personal, of such person but only after same has been entered and docketed of record by the prothonotary of the county where such is situated. The board may, at any time, transmit to the prothonotaries of the respective counties certified copies of all such liens, and it shall be the duty of each prothonotary to enter and docket the same of record in his office, and to index the same as judgments are indexed, without requiring the payment of costs as a condition precedent to the entry thereof.

B. PENNSYLVANIA FISH LAWS

CHAPTER VIII—POLLUTION

SECTION 200. *Pollution of Waters Prohibited; Explosives.*

No person shall put or place in any waters within or on the boundaries of this Commonwealth any electricity, explosives or any poisonous substances whatsoever for the purpose of catching, injuring, or killing fish, except that, for the purposes of fish management, agents of or persons authorized by the Commission under the supervision of the Executive Director may use any method or means of eradication or control of fish. No person shall allow any substance of any kind or character, deleterious, destructive or poisonous to fish, to be turned into or allowed to run, flow, wash or be emptied into any waters within this Commonwealth, unless it is shown to the satisfaction of the Commission or to the proper court that every reasonable and practicable means has been used to abate and prevent the pollution of waters in question by the escape of deleterious substances.

SECTION 202. *Penalty*

Any person violating the preceding provisions of this article shall, on conviction as provided in chapter 14 of this act, be sentenced to pay a fine of not less than one hundred dollars ($100.00) nor more than one thousand dollars ($1,000.00).

SECTION 202.1 *Civil Suits*

(a) The Commonwealth in its sovereign capacity as the guardian and trustee for the people of Pennsylvania of all the natural resources of Pennsylvania, including fish and aquatic life, is hereby declared to have sufficient interest in said fish, and aquatic animals living in a free state to give it standing, through its duly authorized agencies, to recover damages in civil action against any person or persons who unlawfully or negligently kill or otherwise destroy any fish or other aquatic animals by pollution.

(b) The proprietary ownership, jurisdiction over and control of fish and aquatic animals living free in nature, including bait-fish and fish-bait, as defined in this act, are hereby declared to have been achieved through the continued expenditure of Commonwealth funds and efforts to protect, perpetuate, propagate and maintain populations of fish, bait-fish and fish-bait within the waters of the Commonwealth as a renewable natural resource of the Commonwealth.

(c) The Fish Commission, as an agency of the Commonwealth duly authorized to regulate, control, manage and perpetuate the fish and other aquatic life in the waters of the Commonwealth may, in addition to criminal penalties provided in this act, bring civil suits in trespass on behalf of the Commonwealth for the value of any fish, bait-fish or fish-bait, destroyed in violation of section 200 of this act.

SECTION 203. *Evidence in Prosecution for Pollution*

In prosecutions under this article for the pollution of waters by substances known to be injurious to fish or to fish food, it shall not be necessary to prove that such substances have actually caused the death of any particular fish.

C. RULES AND REGULATIONS— DEPARTMENT OF ENVIRONMENTAL RESOURCES

ARTICLE 800—SPECIAL REGULATIONS (of the former Sanitary Water Board)

SECTION 1. *Notice Concerning Endangering Waters of the Commonwealth*

Whenever, because of an accident or otherwise, any toxic, or taste-and-odor producing substance, or any other substance which would endanger downstream users of the waters of the Commonwealth, or would damage property, is discharged into these waters, or is so placed that it might flow, be washed, or fall into them, it shall be the responsibility of the person at the time in charge of such substance to forthwith notify the State Department of Environmental Resources by telephone of the location and nature of the danger, and it shall be his further duty to immediately take all practical steps to prevent injury to property and downstream users of said waters.

SECTION 3. *Use of Algacides, Herbicides, and Fish Control Chemicals*

Except where the use of an algacide, herbicide or fish control chemical would be in violation of a specific Departmental order or permit, such use is authorized in the following instances only: (a) Copper sulfate required to control algae in a source of public water supply where such use is pursuant to and in accordance with approval given by the Commonwealth; (b) chemicals required to control aquatic plants in surface waters and chemicals required for the management of fish populations where such use is pursuant to and in accordance with joint approval given by the Department of Environmental Resources and the Fish Commission.

IV. Aquatic Plants and Herbicides

Since most herbicides are specific for certain species of aquatic plants, it is *IMPORTANT THAT ALL AQUATIC PLANTS ARE ACCURATELY IDENTIFIED BEFORE BEING TREATED.* Aid in identification of aquatic plants can be obtained by contacting a local college or university biology department, county agriculture agent, or your farm and garden supply store.

A. General Groups of Aquatic Plants

1. Algae—A group of small (microscopic), primitive chlorophyll-bearing plants distinguished by their lack of true leaves and flowers. Reproduction is by means of simple cell division or the production of tiny spores. They are found floating or attached to submerged surfaces in most ponds, reservoirs and lakes. They can become very abundant, especially during the hot summer months and extensive periods of bright, calm days.

2. Free Floating Plants—Plants which float freely on the surface of the water. A common example is duckweed.

3. Submerged Plants—Those in which the main portion of the plant is under the water surface. They are usually attached or rooted to the lake or pond bottom. The root system is rather weak and usually serves only to attach the plant to the bottom. Nutrients for maintenance and growth are absorbed directly through the leaf surfaces. Most of these plants are capable of regeneration if a portion of the main plant is broken off. These plants are commonly called coontail, milfoil, bladderwort, pondweeds, or waterweed.

4. Emergent Plants—Plants rising above the water surface, usually found growing in shallow water areas or along the shoreline of lakes and ponds. They may be annual or perennial with a well developed root system through which nutrients are obtained. Common examples include cattails, water lilies, arrowhead, water smartweed, or watershield.

B. AQUATIC PLANT IDENTIFICATION AND CONTROL

ALGAE

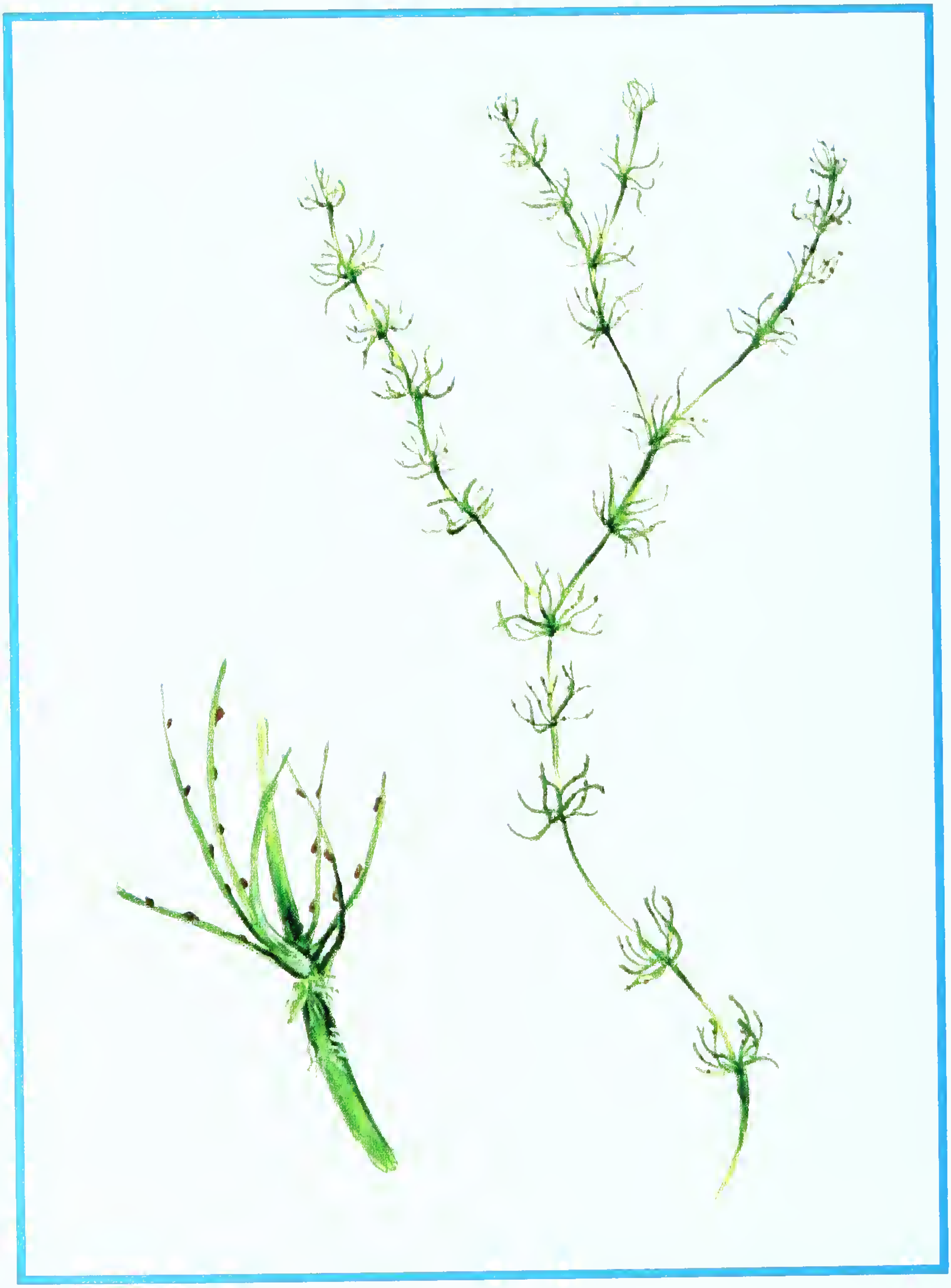
Plankton Algae are often referred to as a "water bloom" or "algae bloom" since they might cause the water to appear soupy green, blue-green, or brown resulting from a large concentration of suspended algae cells in the upper two feet of water. Common examples of "water bloom" include blue-green algae such as *Anacystis, Anabaena, Oscillatoria,* and *Aphanizomenon* and several of the more common species of green algae. Plankton algae can normally be controlled by treating the upper (4) feet of water. The suggested herbicide treatments are as follows:

HERBICIDE	CONCENTRATION	DOSAGE
Copper Sulfate	0.25 to 1.0 ppm	0.68 to 2.7 lbs./A.F.
Cutrine	0.2 ppm	0.75 gal./A.F.
Hydrothol 47 (granular)	0.3 ppm	16 lbs./A.F.
Hydrothol 47 (liquid)	0.3 ppm	0.5 gal./A.F.

Filamentous Algae are commonly referred to as "pond scum." It consists of growths of long-stringy, hair-like strands which start to grow on the bottom of lakes and ponds. As growth continues, they eventually form floating green masses called "mats" or "nets" on the surface of the water. Some of the green and brown scums may be slimy or cottony in appearance. Common examples are: *Spirogyra*—slimy and green; *Cladophora*—cotton mat; *Pithophora*—horse hair clump; and *Hydrodictyon*—water net type. The suggested herbicide treatments are as follows:

HERBICIDE	CONCENTRATION	DOSAGE
Copper Sulfate	0.25 to 1.0 ppm	0.68 to 2.7 lbs./A.F.
Cutrine	0.2 ppm	0.75 gal./A.F.
Diquat	0.5 ppm	0.7 gal./A.F.
Hydrothol 47 (granular)	0.3 ppm	16 lbs./A.F.
Hydrothol 47 (liquid)	0.3 ppm	0.5 gal./A.F.

ppm=parts per million A.F.=acre foot



CHARA

Chara and Nitella

Chara and *Nitella* are advanced forms of algae commonly referred to as "Stonewort" or "Muskgrass" and unique in their possession of cylindrical whorled branches. Each joint of the stem consists of a single cell. *Chara* and *Nitella* grow from the lake bottom with stems and branches that feel bristly or gritty to the touch. They may have a musky odor, are usually found in hard water and often have incrustations of lime. *Chara* may be distinguished from *Nitella* in that the latter is more slender, fragile, and relatively smooth. These two algae resemble the flowering submerged aquatic weeds and are often confused with them. These algae may be treated as follows:

HERBICIDE	CONCENTRATION	DOSAGE
Cutrine	0.4 ppm	1.50 gal./A.F.
Hydrothol 47 (granular)	0.3 ppm	16 lbs./A.F.
Hydrothol 47 (liquid)	0.3 ppm	0.5 gal./A.F.

ppm=parts per million A.F.=acre foot

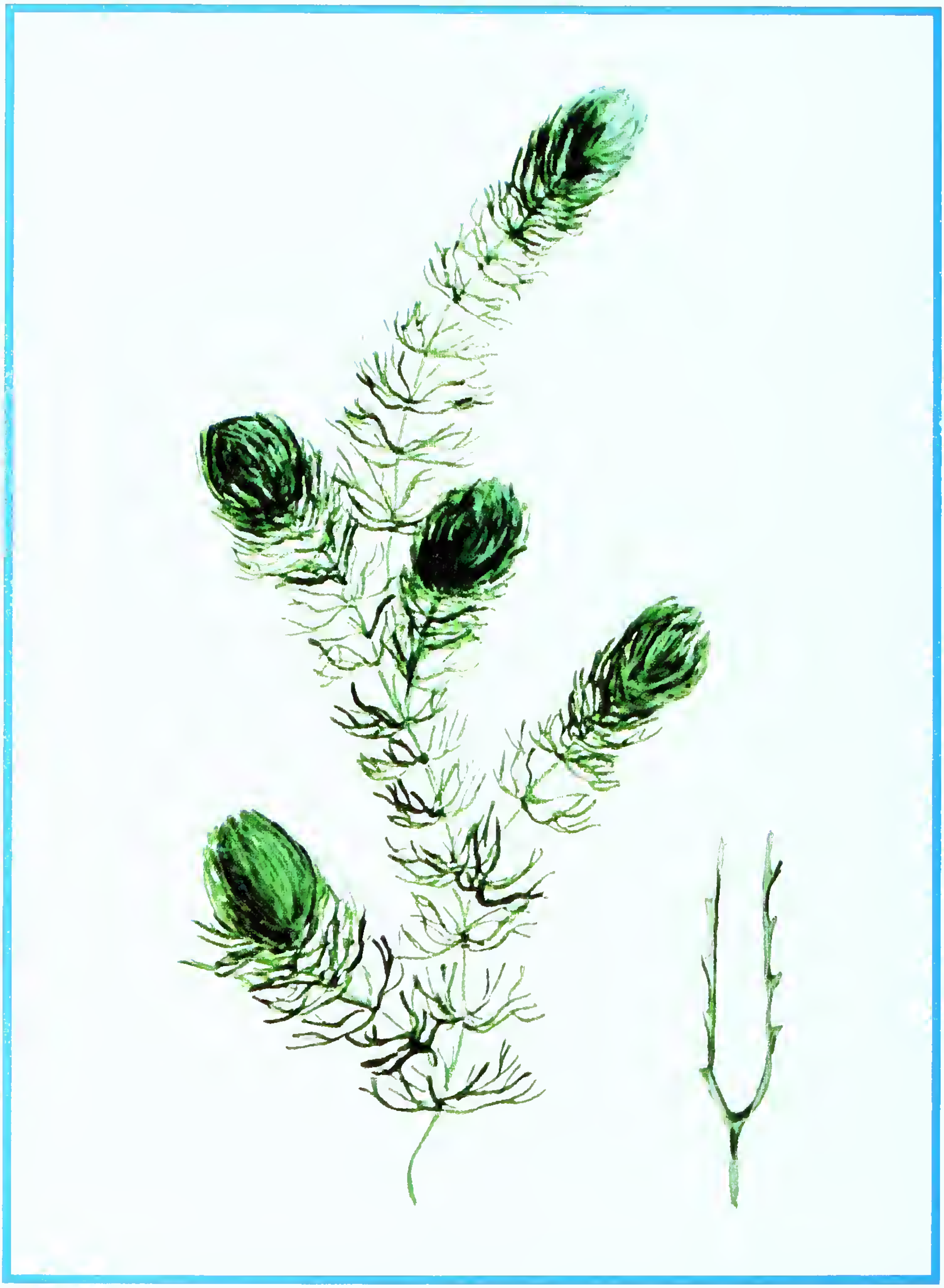
DUCKWEED

Lemna (Duckweed)

Lemna (Duckweed) are free floating plants which often form a green "blanket" on the water surface. These plants do not have leaves, but posses leaf-like, round, flattened fronds. *Lemna* (Duckweed) has one root to each joint and is green beneath. These plants are usually found in hard water and frequently their growth is so abundant that a thick layer (1-2″) may cover the entire water surface. The reproductive ability, the size of the plants, and the layers of the plants which result from wind and wave action, all complicate the techniques necessary for their control. Complete eradication is desirable and should be attempted very early in the growing season. The herbicide should be applied as a very fine spray and efforts made to cover as many plants as possible. A second application should follow within 7 to 10 days for most effective control. The liquid herbicide listed below can be used in control of these plants.

HERBICIDE	DOSAGE
Diquat	1 gal./S.A.

S.A.=surface acre



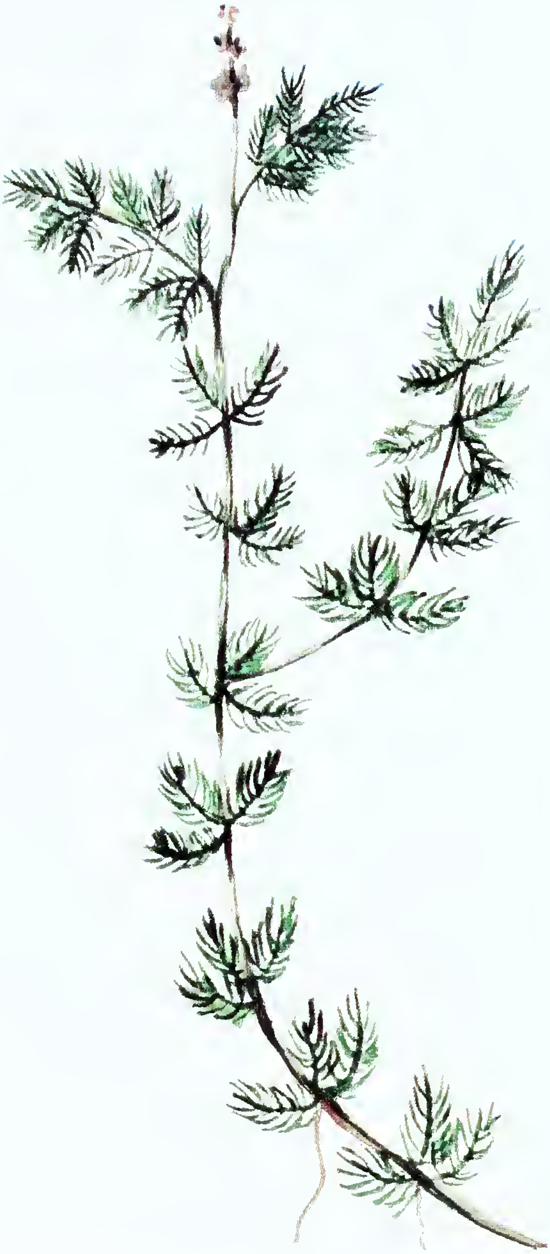
COONTAIL

Ceratophyllum (Coontail)

Ceratophyllum (Coontail) are plants entirely submerged, without roots and appear olive green when observed through the water. Their leaves are arranged in whorls, are repeatedly forked, and have threadlike divisions with teeth along one side. The common name "coontail" comes from the appearance of leaves crowded toward the tip, similar to the tail of a raccoon. Extensive growths of coontail resemble an underwater forest of "Christmas trees." Coontail is usually found in hard water growing to depths up to 15 feet depending on light penetration. *DO NOT CONFUSE COONTAIL WITH CHARA OR MYRIOPHYLLUM.* Coontail can be treated as follows:

HERBICIDE	CONCENTRATION	DOSAGE
Aqua-Vex	2.2 ppm	1 gal./A.F.
Aqua-Vex Granular	1.9 ppm	25 lbs/A.F.
Kuron	2.0 ppm	1.4 gals./A.F.
Aqua-Kleen 20 Granular		150 to 200 lbs./S.A.
Chipman 2, 4-D Granular 20		200 lbs./S.A.
Aquathol K	1.0 to 2.0 ppm	0.67 to 1.25 gals./A.F.
Aquathol Granular	1.0 to 2.0 ppm	27 to 54 lbs./A.F.
Diquat		2 gals./S.A.

ppm=parts per million A.F.=acre foot S.A.=surface acre



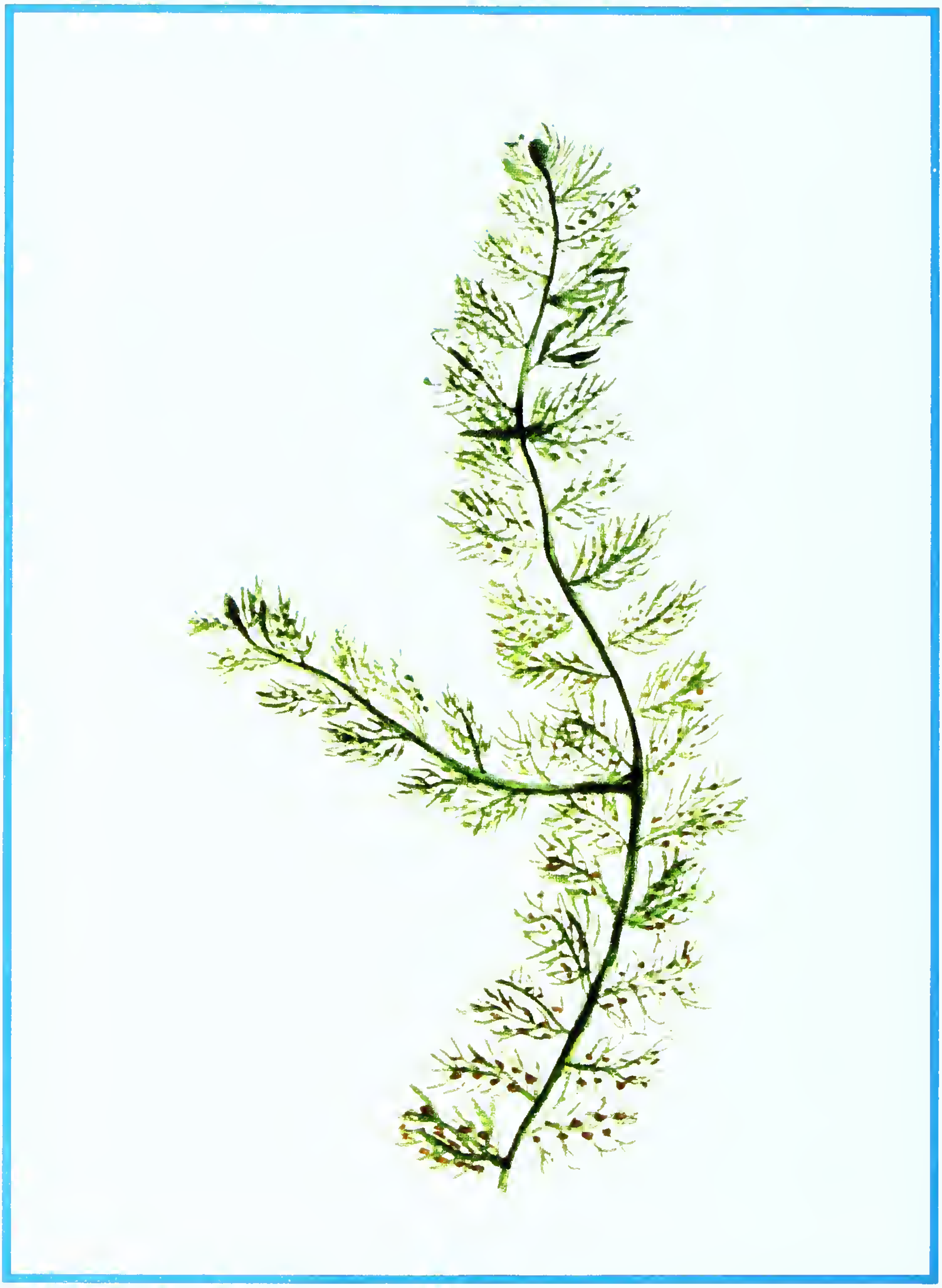
MILFOIL

Myriophyllum (Milfoil)

Myriophyllum (Milfoil) has submerged, feather-like leaves with one central axis; branches are arranged in whorls about the stem. The stems are usually very limp. Milfoil grows entirely under the water and may be found growing in depths of 8 to 10 feet. Its small purplish flowers grow near the stem tips where leaves may differ in size and shape from those at the base. Milfoil can be treated as follows:

HERBICIDE	CONCENTRATION	DOSAGE
Aqua-Vex	2.2 ppm	1 gal./A.F.
Aqua-Vex Granular	1.9 ppm	25 lbs./A.F.
Kuron	2.0 ppm	1.4 gals./A.F.
Aquathol K	2 to 3 ppm	1.25 to 2 gals./A.F.
Aquathol Granular	2 to 3 ppm	54 to 81 lbs./A.F.
Diquat		1 to 2 gals./S.A.
Aqua-Kleen 20 Granular		100 lbs./S.A.
Chipman 2, 4-D Granular 20		100 to 150 lbs./S.A.

ppm=parts per million A.F.=acre foot S.A.=surface acre



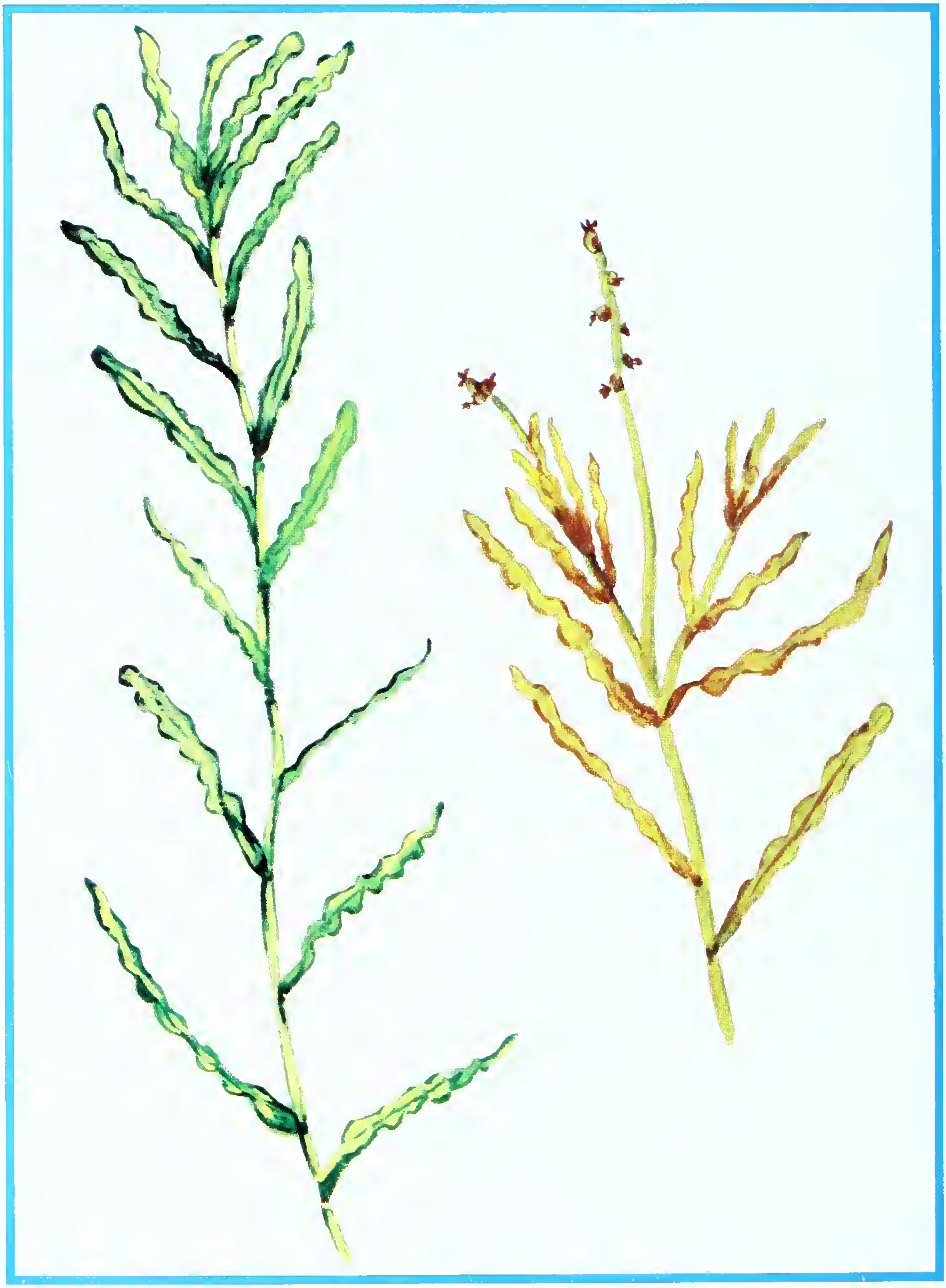
BLADDERWORT

Utricularia (Bladderwort)

Utricularia (Bladderwort) are small herbs with tiny bladder-like sacs adapted to catch small animal life. Their flowers are yellow or purple with two lips; the upper lip is erect, the lower one has a spur. The leaves of bladderwort are irregularly forked. Bladderwort may be treated as follows:

HERBICIDE	CONCENTRATION	DOSAGE
Aqua-Vex	2.2 ppm	1 gal./A.F.
Aqua-Vex Granular	1.9 ppm	25 lbs./A.F.
Kuron	2.0 ppm	1.4 gals./A.F.
Aqua-Kleen 20 Granular	2 to 3 ppm	150 to 200 lbs./S.A.
Aquathol Plus	2 to 3 ppm	1 to 1.67 gals./A.F.
Aquathol Plus Granular	2 to 3 ppm	51 to 77 lbs./A.F.
Diquat		1 to 2 gals./S.A.
Chipman 2, 4-D Granular 20		100 to 150 lbs./S.A.

ppm=parts per million A.F.=acre foot S.A.=surface acre



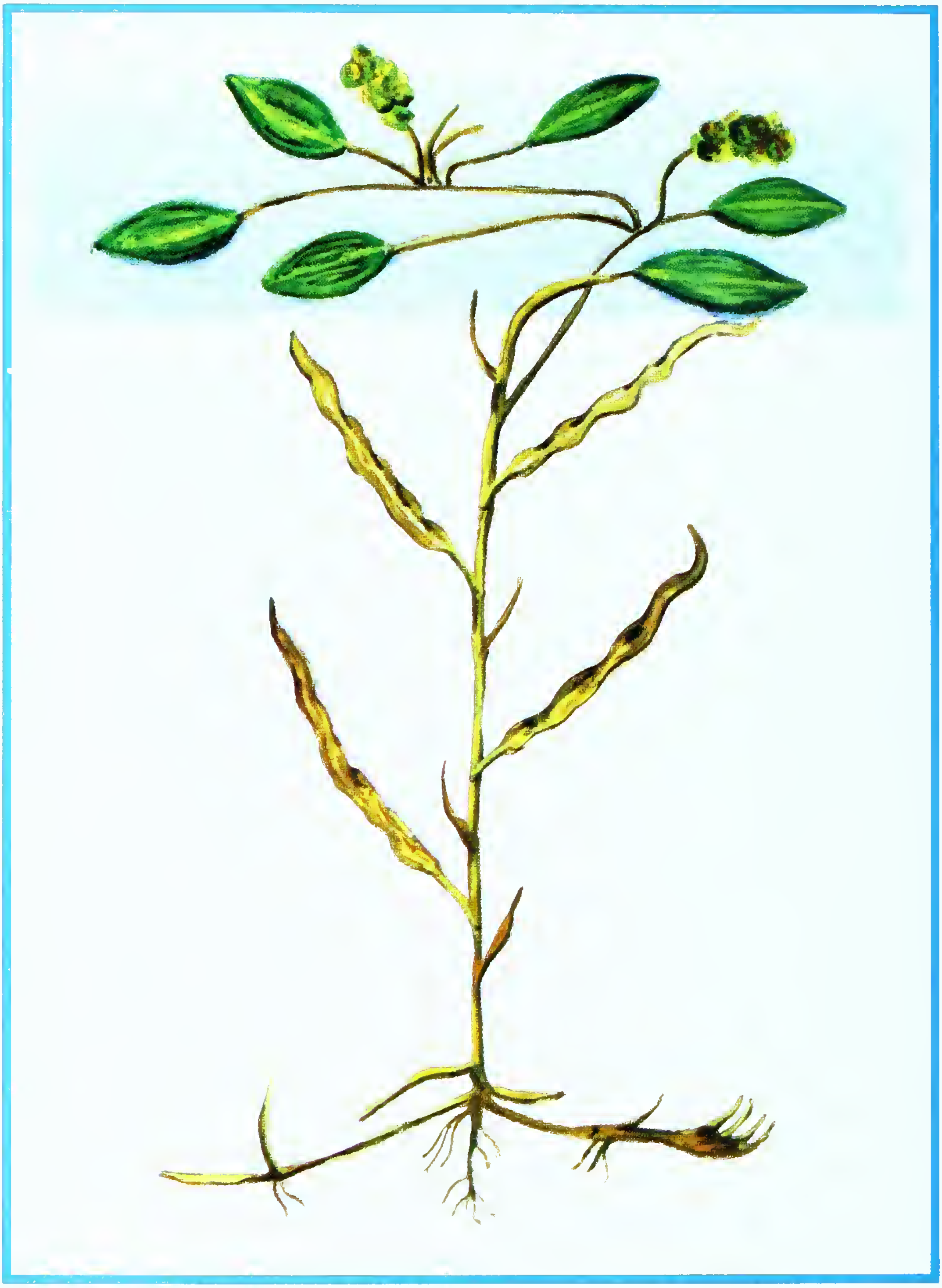
CURLYLEAF PONDWEED

Potamogeton (Pondweed)

Curlyleaf pondweed has thin membranous leaves approximately one half inch wide and two to three inches in length. The leaves are wavy or curly along the edges with a row of small spines visible to the naked eye. These plants grow along the shoreline to depths of about 12 feet. Curlyleaf pondweed may start growing in the fall and during the winter months. Seeds can be produced in late April or early May and then the plant may die down during late July.

HERBICIDE	CONCENTRATION	DOSAGE
Aquathol K	0.5 to 1.5 ppm	0.33 to 1.00 gal./A.F.
Aquathol Granular	0.5 to 1.5 ppm	13 to 40 lbs./A.F.
Diquat	1 to 2 ppm	2 gals./S.A.
Aquathol Plus	1 to 2 ppm	0.5 to 1 gal./A.F.
Aquathol Plus Granular	1 to 2 ppm	26 to 51 lbs./A.F.
Chipman 2, 4-D Granular 20		200 lbs./S.A.

ppm=parts per million A.F.=acre foot S.A.=surface acre



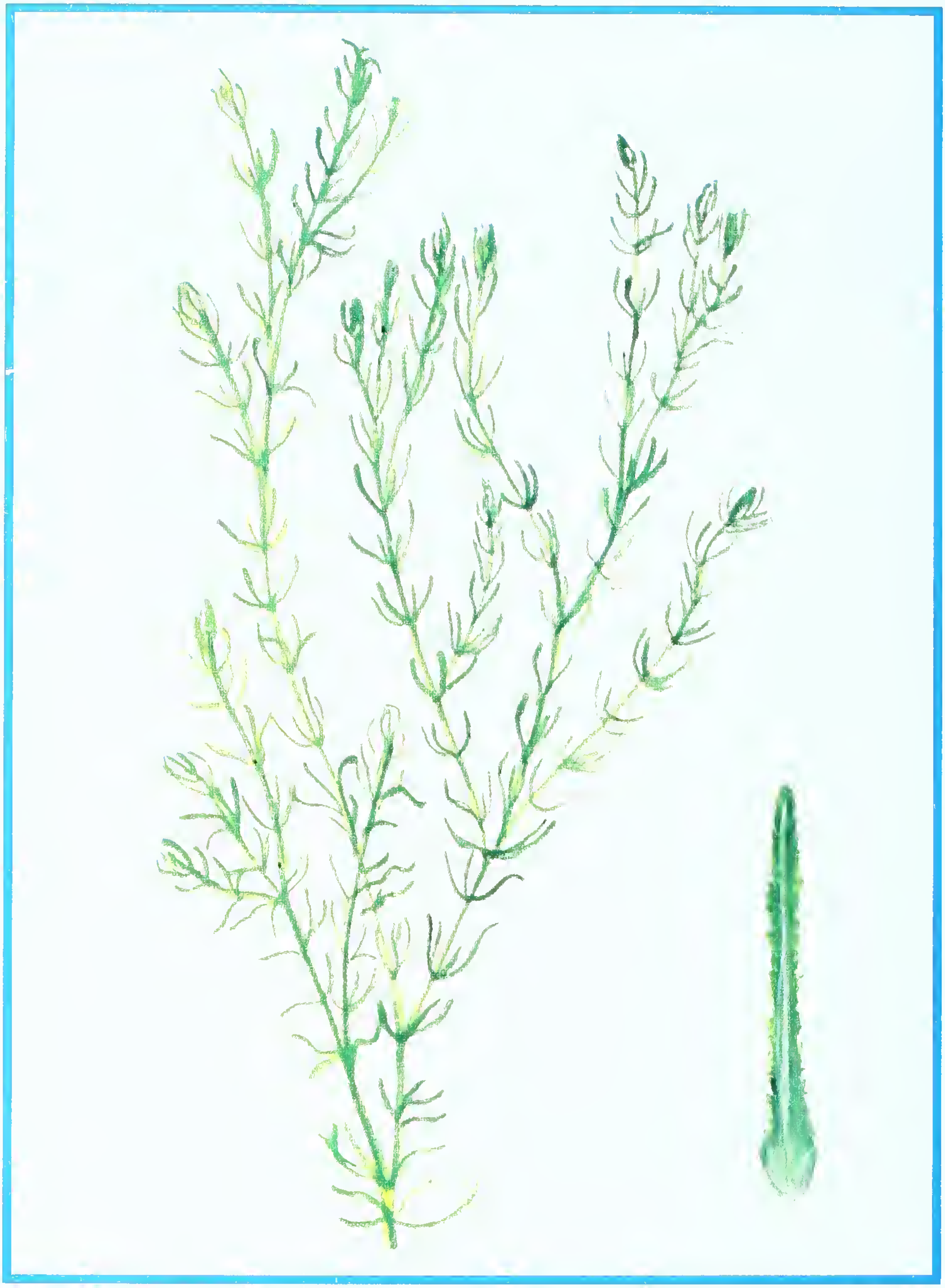
AMERICAN PONDWEED

Potamogeton (Pondweed)

American pondweed has very thin submersed leaves, linear in shape, and floating leaves that are large and elliptic in shape. This is the most common of the floating leaf pondweeds in Pennsylvania.

HERBICIDE	CONCENTRATION	DOSAGE
Aquathol K	1 to 2 ppm	0.67 to 1.25 gals./A.F.
Aquathol Granular	1 to 2 ppm	27 to 54 lbs./A.F.
Diquat		2 gals./S.A.
Aquathol Plus	1 to 2 ppm	0.5 to 1 gal./A.F.
Aquathol Plus Granular	1 to 2 ppm	26 to 51 lbs./A.F.
Chipman 2, 4-D Granular 20		200 lbs./S.A.

ppm=parts per million A.F.=acre foot S.A.=surface acre



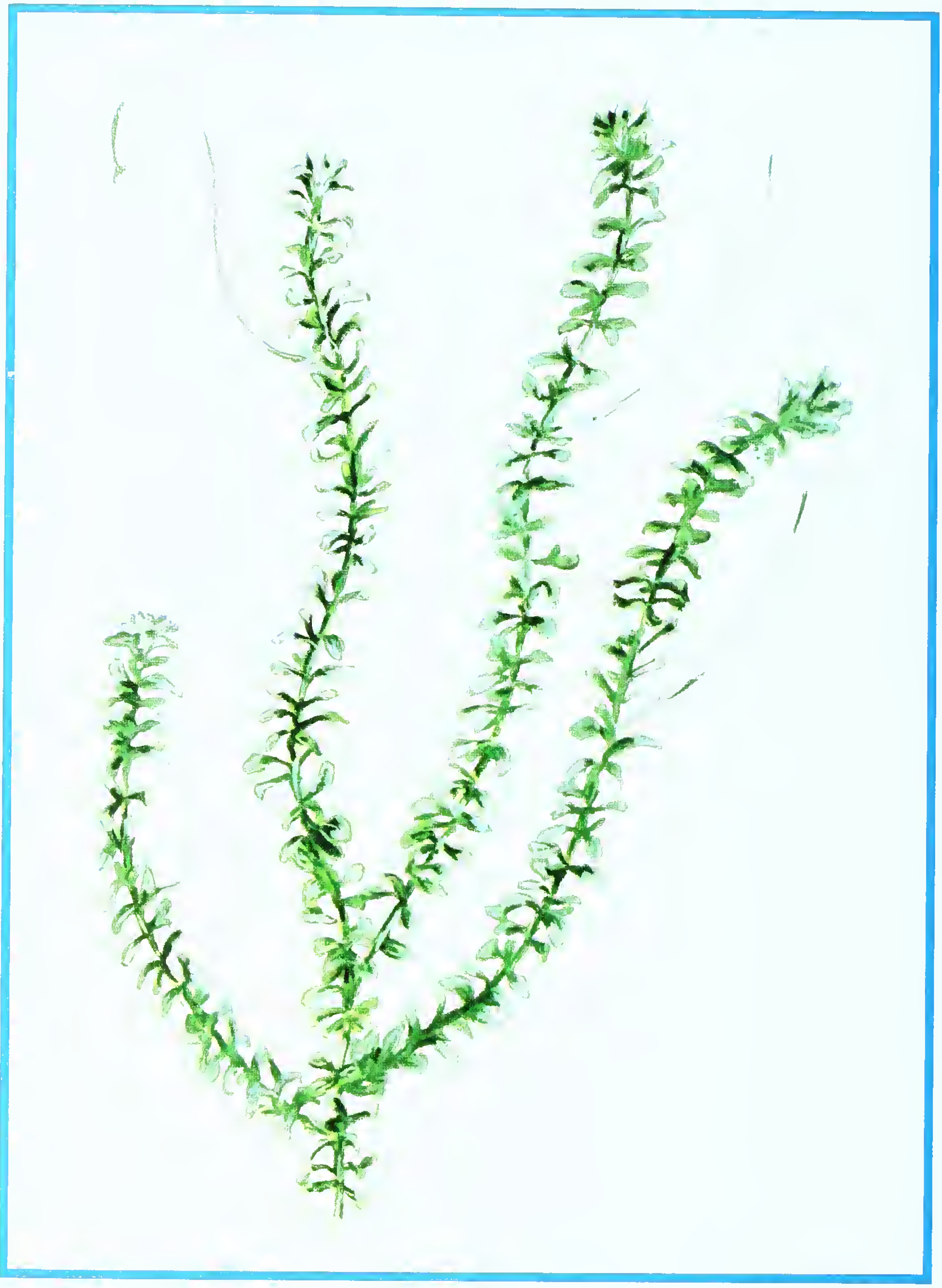
NAJAS

Najas (Bushy Pondweed)

Najas (Bushy Pondweed) has toothed, thread-like leaves which are enlarged at the base and the plants are bushy in appearance. Bushy Pondweed can be treated as follows:

HERBICIDE	CONCENTRATION	DOSAGE
Diquat		1 gal./S.A.
Aquathol K	0.5 to 1.5 ppm	0.33 to 1 gal./A.F.
Aquathol Granular	0.5 to 1.5 ppm	13 to 40 lbs./A.F.
Aquathol Plus	2 to 3 ppm	1 to 1.67 gals./A.F.
Aquathol Plus Granular	2 to 3 ppm	51 to 77 lbs./A.F.
Aqua-Kleen 20 Granular		150 to 200 lbs./A.F.
Chipman 2, 4-D Granular 20		200 lbs./A.F.

ppm=parts per million A.F.=acre foot S.A.=surface acre



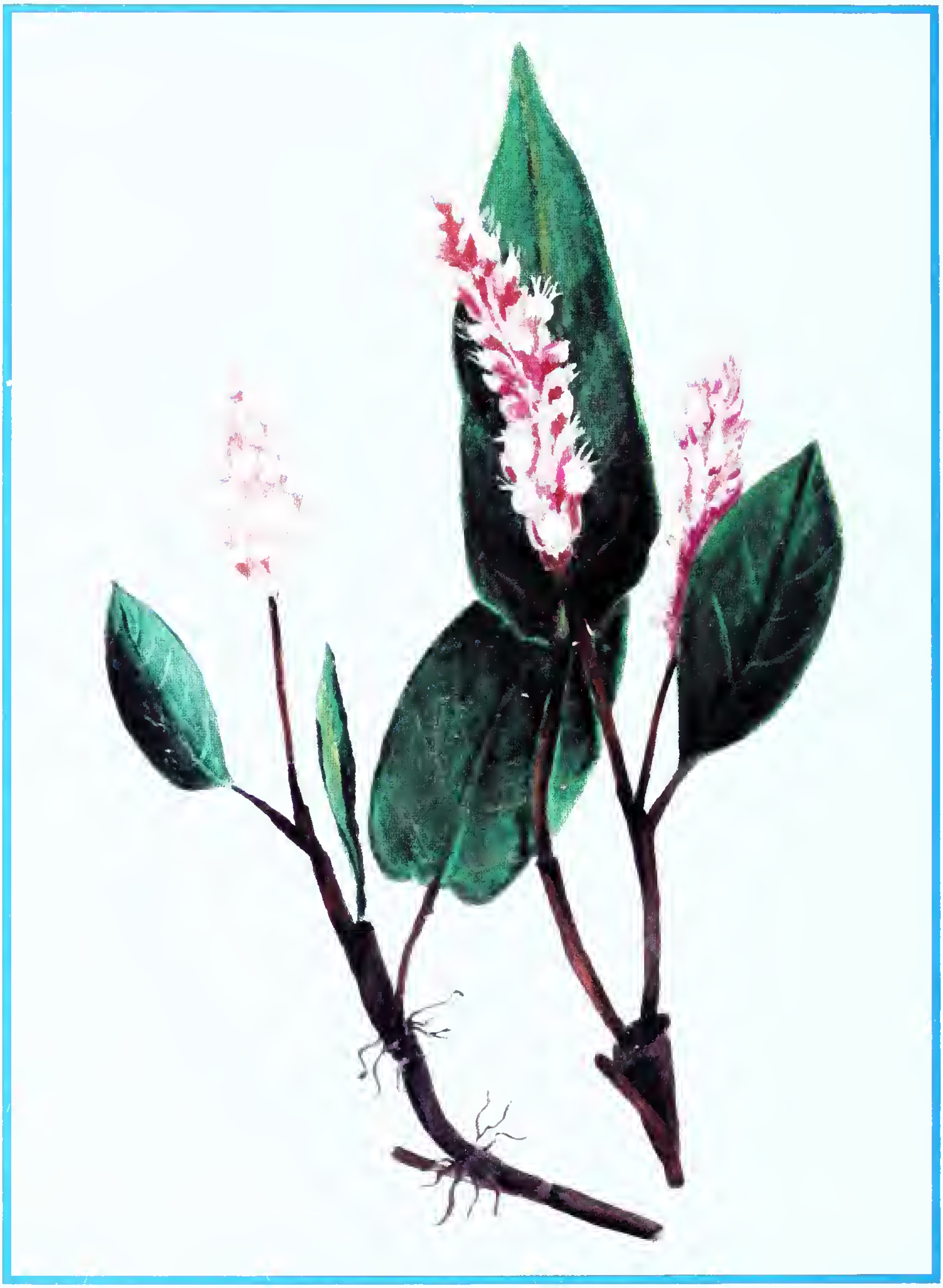
ELODEA

Elodea (Waterweed)

Elodea (Waterweed) grows entirely submersed with the leaves in whorls around the main stem. The stems are branched and form large masses near the bottom. The leaf margins have small microscopic teeth and the leaves surround the stem at their bases. Waterweed can be treated as follows:

HERBICIDE	CONCENTRATION	DOSAGE
Diquat		2 gals./S.A.
Aquathol Plus	1 to 2 ppm	0.5 to 1 gal./A.F.
Aquathol Plus Granular	1 to 2 ppm	26 to 51 lbs./A.F.
Aqua-Vex	2.2 ppm	1 gal./A.F.
Aqua-Vex Granular	1.9 ppm	25 lbs./A.F.
Kuron	2.0 ppm	1.4 gals./A.F.
Chipman 2, 4-D Granular 20		200 lbs./S.A.

ppm=parts per million A.F.=acre foot S.A.=surface acre



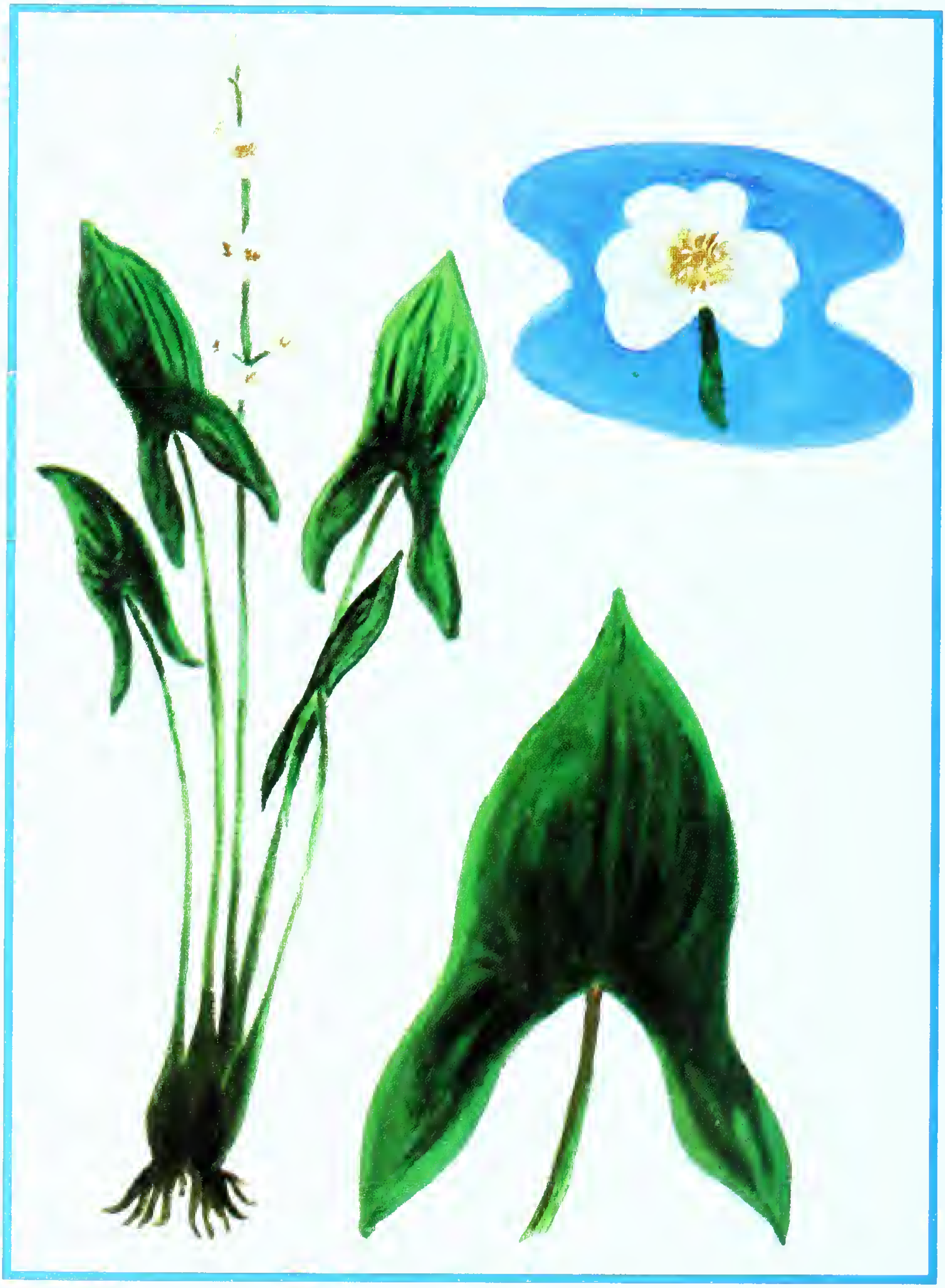
POLYGONUM

Polygonum (Water Smartweed)

Polygonum (Water Smartweed) has jointed stems which are swollen at the joints and creeping rootstocks. The stems have alternate, simple oblong leaves about 4 inches in length. The flowers vary in color from dark pink to rose and project above the water. Water Smartweed can be found growing along the shoreline in shallow water of ponds and lakes. Water Smartweed can be treated as follows:

HERBICIDE	DOSAGE
Chipman 2, 4-D Granular	400 lbs./S.A.

S.A.=surface acre



ARROWHEAD

Sagittaria (Arrowhead)

Sagittaria (Arrowhead) have four types of leaves; the arrowheads are the most common. The arrowhead and elliptical leaf types are emergent while the tongue-like and ribbon-like are submergent. The flowers are small and white. *Sagittaria* are characterized by fleshy or tuber-bearing rootstocks and rosettes surrounding the basal leaves. These plants grow along the edge of lakes and ponds in shallow water. *Sagittaria* can be treated as follows:

HERBICIDE	CONCENTRATION	DOSAGE
Aquathol Plus	2 to 3 ppm	1 to 1.67 gals./A.F.
Aquathol Plus Granular	2 to 3 ppm	51 to 77 lbs./A.F.
Chipman 2, 4-D Granular 20		400 lbs./S.A.

ppm=parts per million A.F.=acre foot S.A.=surface acre

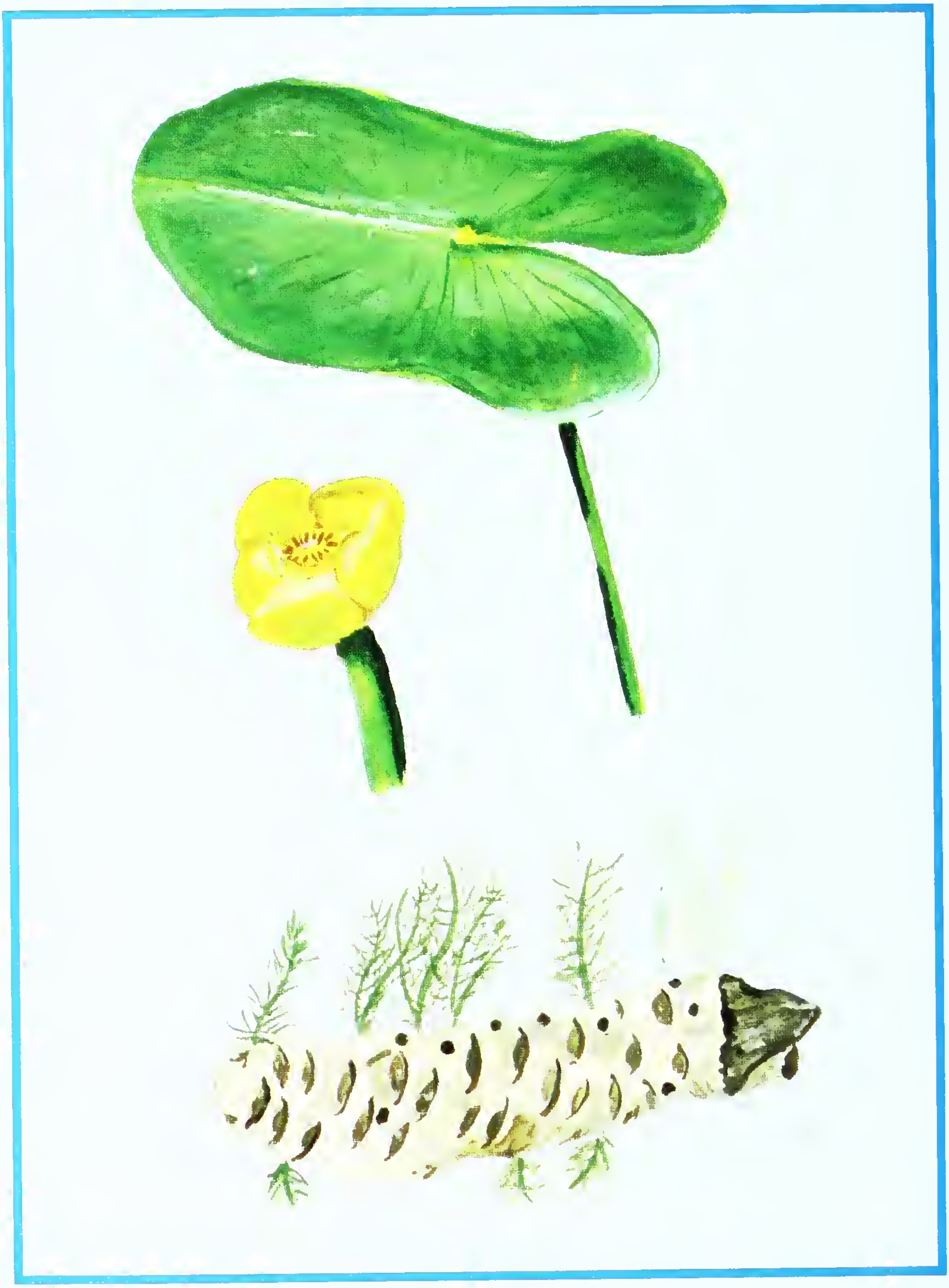
WHITE WATERLILY

Nymphae (White Water Lilies)

Nymphae (White Water Lilies) have large (up to 15 in. wide) circular, floating leaves with a slit from the edge to the center of the leaf. The flowers, which float, vary in color from white to pink. The underground stems are thick and fleshy. White Water Lilies are commonly found in shallow water and can be treated as follows:

HERBICIDE	CONCENTRATION	DOSAGE
Aqua-Vex	2.2 ppm	1 gal./A.F.
Aqua-Vex Granular	1.9 ppm	25 lbs./A.F.
Aqua-Kleen 20 Granular		150 to 200 lbs./S.A.
Chipman 2, 4-D Granular 20		150 lbs./S.A.

ppm=parts per million   A.F.=acre foot   S.A.=surface acre



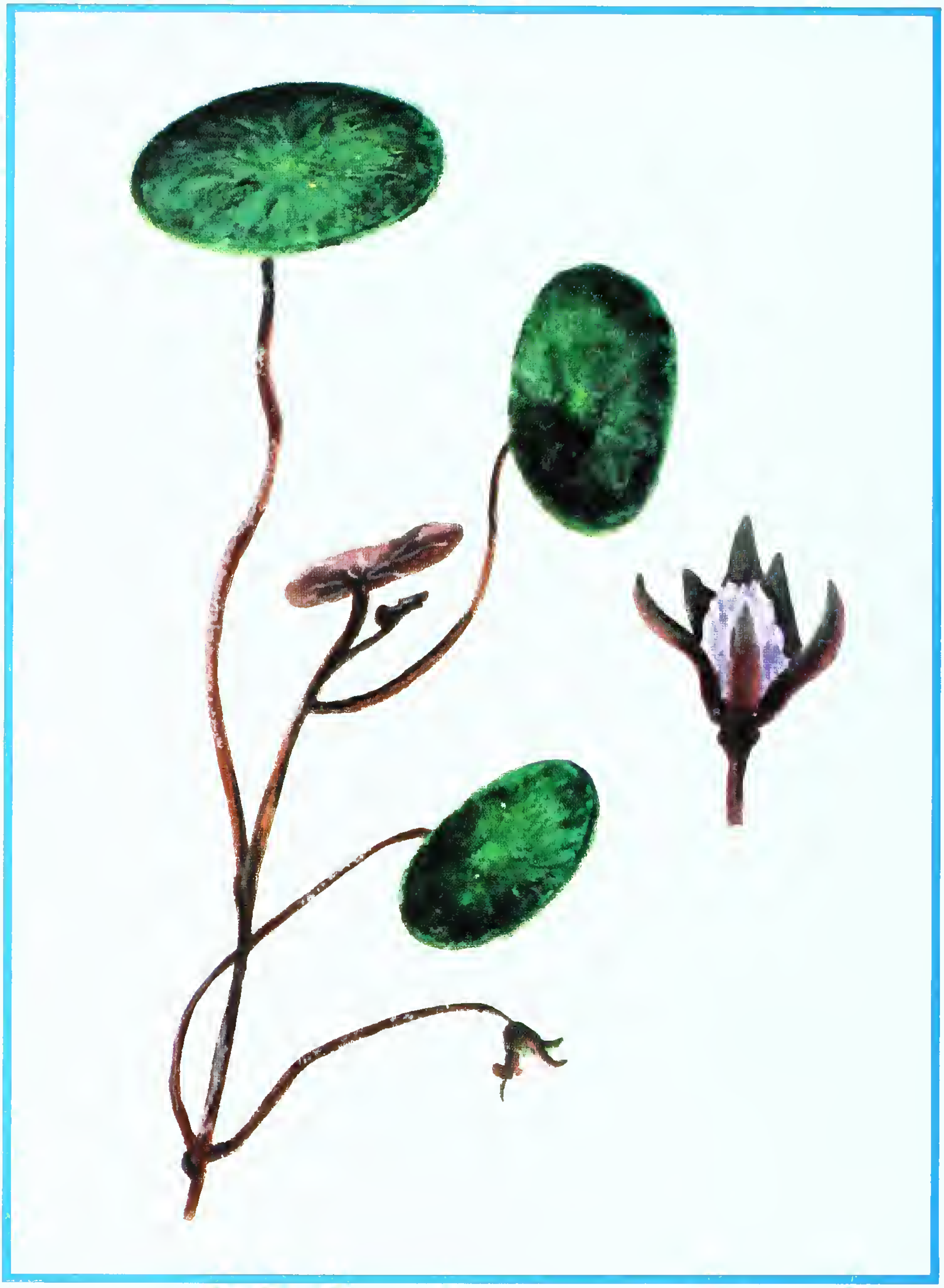
SPATTERDOCK

Nuphar (Spatterdock)

Nuphar (Spatterdock) is commonly called yellow pond lily or cow lily. The heart-shaped leaves are either floating or erect and are about one foot in diameter. The underground stem is very thick and spongy. The yellow flowers have 5 to 6 fleshy cupped sepals and small, scale-like petals. The flowers form a ball with the petals curved inward. The fruit is fleshy, somewhat globular and contains many seeds. Spatterdock can be treated as follows:

HERBICIDE	CONCENTRATION	DOSAGE
Aqua-Vex	2.2 ppm	1 gal./A.F.
Aqua-Vex Granular	1.9 ppm	25 lbs./A.F.
Aqua-Kleen 20 Granular		150 to 200 lbs./S.A.
Chipman 2, 4-D Granular 20		150 lbs./S.A.
Aquathol Plus	2 to 3 ppm	1 to 1.67 gals./A.F.
Aquathol Plus Granular	2 to 3 ppm	51 to 77 lbs./A.F.

ppm=parts per million A.F.=acre foot S.A.=surface acre



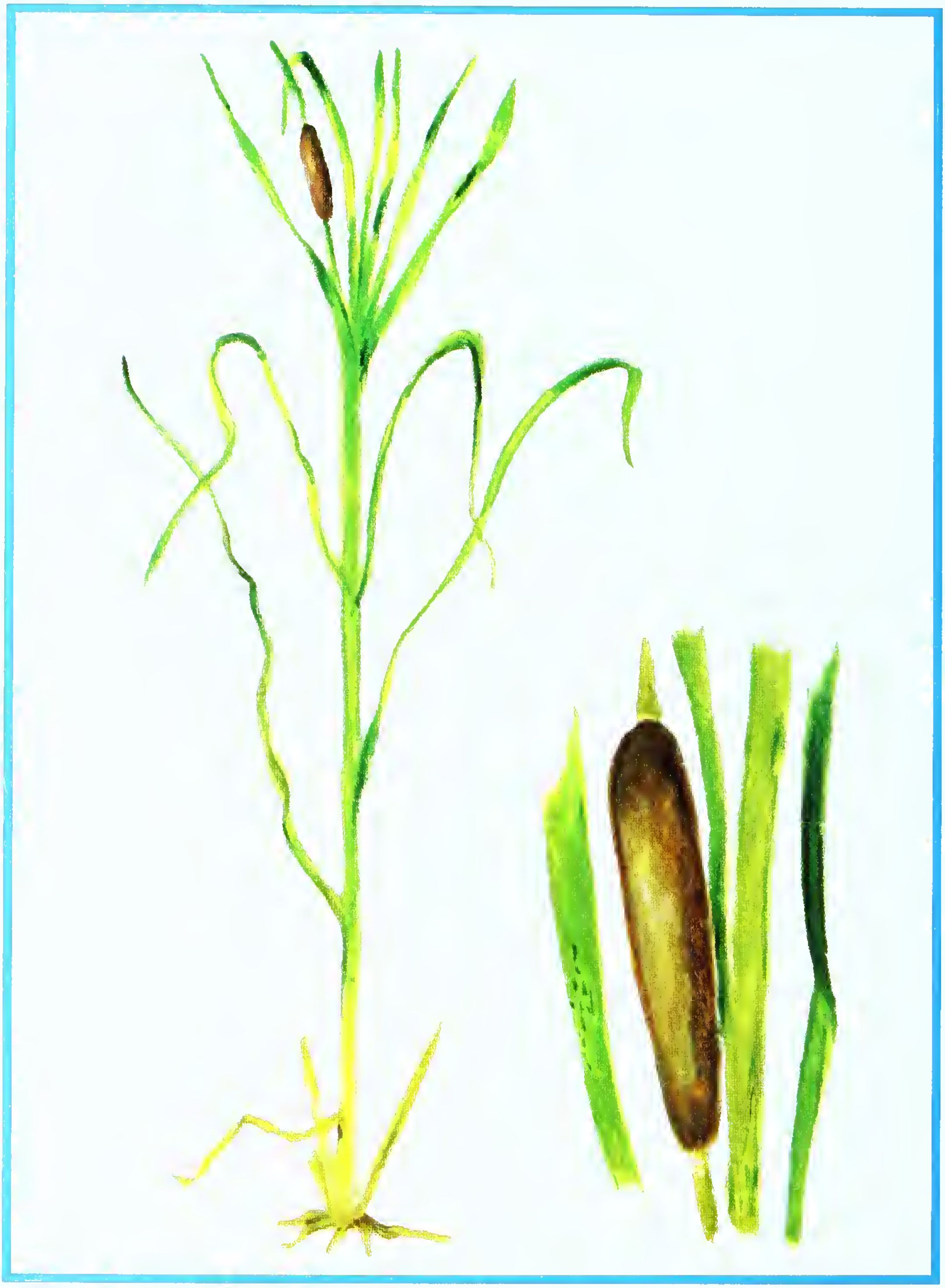
WATERSHIELD

Brasenia (Watershield)

Brasenia (Watershield) has floating leaves the shape of a shield. The stem is attached to the middle of the leaf. Leaves vary in length from two (2) to five (5) inches and the underside is usually covered with a thick layer of gelatinous material. Watershield can be treated as follows:

HERBICIDE	CONCENTRATION	DOSAGE
Chipman 2, 4-D Granular 20		150 to 200 lbs./S.A.
Aqua-Kleen 20 Granular		150 to 200 lbs./S.A.
Aquathol Plus	2 to 3 ppm	1 to 1.67 gals./A.F.
Aquathol Plus Granular	2 to 3 ppm	26 to 77 lbs./A.F.

ppm=parts per million A.F.=acre foot S.A.=surface acre



CATTAIL

Typha (Cattail)

Typha (Cattail) are tall erect plants with long, flat leaves which are about one inch in width. The flowers are borne in close cylindrical spikes which consist of two portions; the pistillate, or female portion is below, and the staminate, or male portion is above. Cattails may appear in almost any wet place and are often the first to appear in a new pond. Cattails *SHOULD BE TREATED BEFORE THEY HAVE FORMED SEED SPIKES*. Cattails can be treated as follows:

HERBICIDE	DOSAGE
Dalapon	4 ounces of powder dissolved in one gallon of water and sprayed on plants to thoroughly wet foliage.
Diquat	1 quart mixed with 25 gallons of water and sprayed on plants to thoroughly wet foliage.

HERBICIDES SUGGESTED FOR USE IN PENNSYLVANIA*

The user of herbicides is cautioned to *FOLLOW THE DIRECTIONS ON THE MANUFACTURERS LABEL.* Some of the chemicals are quite toxic to humans, animals, fish and other aquatic life.

HERBICIDE	AMOUNT ACTIVE INGREDIENT	COST (EST.)
Copper Sulfate	Copper Sulfate—100%	36¢/lb.
Cutrine	Copper Derivative of Copper Triethanolamine Complex—7.10%	$17/gal.
Aqua-Kleen 20 Granular	20% 2, 4-D acid equivalent (butoxy ethanol ester)	30¢/lb.
Chipman 2, 4-D Granular 20	20% 2, 4-D acid equivalent (isoctyl ester)	33¢/lb.
Aqua-Vex	Silvex—6 lbs./gal. acid equivalent	$17/gal.
Aqua-Vex Granular	Silvex—20% acid equivalent	72¢/lb.
Kuron	Silvex—4 lbs./gal. acid equivalent	$12/gal.
Aquathol K	3.0 lbs. Endothall acid equivalent per gallon	$14.25/gal.
Aquathol Granular	Dipotassium salt of Endothall—10.1%	41¢/lb.
Aquathol Plus	1.7 lbs. Endothall acid equivalent and 2.4 lbs. Silvex acid equivalent per gallon	$15/gal.
Aquathol Plus Granular	Dipotassium Salt of Endothall 5.1% Potassium Salt of Silvex 5.6%	42¢/lb.
Diquat	2 lbs. of cation per gallon	$34/gal.
Dalapon	85%—sodium salt of 2, 2-Dichloropropionic acid	87¢/lb.
Hydrothol 47	1.5 lbs. Endothall acid equivalent per gallon	$13.75/gal.
Hydrothol 47 Granular	5% Endothall acid equivalent	56¢/lb.

* Subject to change

Conversion Tables

TABLE 1—Gallons of liquid chemical needed (based on the pounds of active ingredient per gallon), to treat one acre foot of water with 1 to 10 parts per million concentration.

Pounds of Active Ingredient Per Gallon	Parts Per Million				
	1	2	3	4	5
1	2.719	5.438	8.157	10.876	13.595
2	1.359	2.718	4.077	5.436	6.795
3	0.906	1.812	2.718	3.624	4.530
4	0.680	1.360	2.040	2.720	3.400
5	0.544	1.088	1.632	2.176	2.720
6	0.453	0.906	1.359	1.812	2.265
7	0.388	0.776	1.164	1.552	1.940
8	0.340	0.680	1.029	1.360	1.700
9	0.302	0.604	0.906	1.208	1.510
10	0.272	0.544	0.816	1.088	1.360

Pounds of Active Ingredient Per Gallon	Parts Per Million				
	6	7	8	9	10
1	16.314	19.033	21.752	24.471	27.190
2	8.154	9.513	10.872	12.231	13.590
3	5.436	6.342	7.248	8.154	9.060
4	4.080	4.760	5.440	6.120	6.800
5	3.264	3.808	4.352	4.896	5.440
6	2.718	3.171	3.624	4.077	4.530
7	2.328	2.716	3.104	3.492	3.880
8	2.040	2.380	2.720	3.060	3.400
9	1.812	2.114	2.416	2.718	3.020
10	1.632	1.904	2.176	2.448	2.720

TABLE 2—Pounds of granular herbicide needed (based on the percent of active ingredient per pound) to treat one acre foot of water with 1 to 10 parts per million concentration.

Percent Active Ingredient	Parts Per Million									
	1	2	3	4	5	6	7	8	9	10
1	270.0	540.0	810.0	1080.0	1350.0	1620.0	1890.0	2160.0	2430.0	2700.0
2	135.0	270.0	405.0	540.0	675.0	810.0	945.0	1080.0	1215.0	1350.0
3	90.0	180.0	270.0	360.0	450.0	540.0	630.0	720.0	810.0	900.0
4	67.5	135.0	202.5	270.0	337.5	405.0	472.5	540.0	607.5	675.0
5	54.0	108.0	162.0	216.0	270.0	324.0	378.0	432.0	486.0	540.0
6	45.0	90.0	135.0	180.0	225.0	270.0	315.0	360.0	405.0	450.0
7	38.6	77.2	115.8	154.4	193.0	231.6	270.0	308.8	347.4	386.0
8	33.8	67.6	101.4	135.2	169.0	202.8	236.6	270.4	304.2	338.0
9	30.0	60.0	90.0	120.0	150.0	180.0	210.0	240.0	270.0	300.0
10	27.0	54.0	81.0	108.0	135.0	162.0	189.0	216.0	243.0	270.0
11	24.5	49.0	73.5	98.0	122.5	147.0	171.5	196.0	220.5	245.0
12	22.5	45.0	67.5	90.0	112.5	135.0	157.5	180.0	202.5	225.0
13	20.8	41.6	62.4	83.2	104.0	124.8	145.6	166.4	187.2	208.0
14	19.3	38.6	57.9	77.2	96.5	115.8	135.1	154.4	173.7	193.0
15	18.0	36.0	54.0	72.0	90.0	108.0	126.0	144.0	162.0	180.0
16	16.9	33.8	50.7	67.6	84.5	101.4	118.3	135.2	152.1	169.0
17	15.9	31.8	47.7	63.6	79.5	95.4	111.3	127.2	143.1	159.0
18	15.0	30.0	45.0	60.0	75.0	90.0	105.0	120.0	135.0	150.0
19	14.2	28.4	42.6	56.8	71.0	85.2	99.4	113.6	127.8	142.0
20	13.5	27.0	40.5	54.0	67.5	81.0	94.5	108.0	121.5	135.0
21	12.9	25.8	38.7	51.6	64.5	77.4	90.3	103.2	116.1	129.0
22	12.3	24.6	36.9	49.2	61.5	73.8	86.1	98.4	110.7	123.0
23	11.7	23.4	35.1	46.8	58.5	70.2	81.9	93.6	105.3	117.0
24	11.3	22.6	33.9	45.2	56.5	67.8	79.1	90.4	101.7	113.0
25	10.8	21.6	32.4	43.2	54.0	64.8	75.6	86.4	97.2	108.0
50	5.4	10.8	16.2	21.6	27.0	32.4	37.8	43.2	48.6	54.0
100	2.7	5.4	8.1	10.8	13.5	16.2	18.9	21.6	24.3	27.0

TABLE 3

1 acre=43,560 square feet (length times width)
1 acre=a square with 208.7 feet on each side
1 acre=a circle with a diameter of 235.4 feet
1 acre foot=325,851 gallons of water
1 acre foot=2,718,144 pounds of water
1 acre foot=43,560 cubic feet of water

Liquid Measurements
1 gallon=4 quarts
1 gallon=8 pints
1 pints=16 ounces
1 cup=8 ounces
¼ cup=2 ounces
½ cup=4 ounces
1 tablespoon=½ ounce
8 tablespoons=4 ounces
16 tablespoons=8 ounces
0.1 gallon=13 ounces
0.2 gallon=26 ounces
0.25 gallon=32 ounces or 1 quart
0.3 gallon=48 ounces
0.4 gallon=51 ounces
0.5 gallon=64 ounces or 2 quarts
0.6 gallon=77 ounces
0.7 gallon=90 ounces
0.75 gallon=96 ounces or 3 quarts
0.8 gallon=102 ounces
0.9 gallon=115 ounces
1.0 gallon=128 ounces or 4 quarts

Solid Measurement—(rounded to nearest half ounce)
0.1 pound=1.5 ounces
0.2 pound=3 ounces
0.3 pound=5 ounces
0.4 pound=6 ounces
0.5 pound=8 ounces
0.6 pound=10 ounces
0.7 pound=11 ounces
0.8 pound=13 ounces
0.9 pound=14 ounces
1.0 pounds=16 ounces
1 part per million=8.345 pounds per million gallons of water
1 part per million=2.7 pounds per acre foot of water
1 gallon of water weighs 8.3453 pounds
1 pound of water equals 0.1198 gallon

GLOSSARY OF ABBREVIATIONS AND DEFINITIONS

A	Acre
A.F. acre-foot	The volume that would cover one acre to a depth of one foot.
Algacide	A special chemical highly toxic to algae. Algacides are often applied to water to control nuisance algal blooms.
Alternate leaves	Leaves borne with but one at each level on the stem.
Axil	The angle between a leaf or a bract and the stem on which it is borne.
Basal	Related to, situated at, or forming the base.
Blade	The expanded, usually flattened, portion of a leaf.
Bloom	A readily visible concentrated growth or aggregation of plankton or algae.
Chlorophyll	The green coloring matter in plants, partly responsible for photosynthesis.
Elliptical	Oval or oblong, with the ends equally narrowed or rounded.
Frond	The green leafless stem.
Globular	Globe-shaped.
Herbicide	Compounds intended to control vegetation.
Opposite leaves	Leaves borne two at a node.
ppm	Parts per million.
Rootstock	An underground stem, usually bearing scale leaves, and with erect stems or leaves at intervals.
Rosette	A cluster of radiating leaves.
Sepal	A modified leaf forming the outer, usually green, whorl of floral parts.
Spike	An elongate inflorescence with flowers growing close together on a common axis.
Spore	A usually miscroscopic one-celled structure serving to reproduce lower plants as seeds do higher plants.
Spur	A more or less elongate saclike organ, usually part of a calyx.
Whorled	Arranged in a circle at one level on the stem.

COMMONWEALTH OF PENNSYLVANIA
FISH COMMISSION–DEPARTMENT OF
ENVIRONMENTAL RESOURCES–
ENVIRONMENTAL QUALITY BOARD

APPLICATION AND PERMIT FOR USE OF AN ALGACIDE, HERBICIDE OR FISH CONTROL CHEMICAL IN WATERS OF THE COMMONWEALTH

Submit all applications (only one copy necessary) to the Benner Spring Fish Research Station, R.D. #1, Box 200-C, Bellefonte, Pennsylvania 16823

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1. Name of applicant (owner) ______________________

   Tel. No. __________ Address of applicant ______________

   ____

2. Person or organization conducting treatment (if other than applicant) ______________________________

   ____

3. Name of water body to be treated ______________________
4. Location of water body: County ______________________

   Township or other municipality ______________________

   Nearest built-up area ______________________________
5. Type of water body: Pond _____ Lake _____ Impoundment _____ Canal _____
6. Uses of water body to be treated:

   Water Supply: Municipal _____ Industrial _____ Livestock _____ Irrigation _____ Fire Protection _____ Other

   ____

   Water Contact Sports: Swimming _____ Skiing _____

   Fishing: Warm water species _____ Cold water species (trout) _____
7. Is water body open for public fishing? Yes _____ No _____

8. Has water body ever been stocked with fish by a State Agency? _____ Federal Agency? _____

9. Does water body have a discharge or overflow of water? Yes _____ No _____ If YES, indicate time of year discharge or overflow will occur ______________________________

10. Name of receiving stream ______________________________

11. Total area of water body: Number of surface acres _________ Treatment area: Number of surface acres _________ Average depth ______________________________

12. Indicate species of algae, plant (s) or fish to be controlled _____
____

13. Commercial name (s) of chemical (s) ______________________________
____

14. Dosage of each chemical per treatment (specify in either pounds or gallons)

(a) __________ per surface acre __________ per surface acre

(b) ____________ per acre foot ____________ per acre foot

____________ per acre foot ____________ per acre foot

(c) Amount of each chemical to be applied in each treatment ______________________________ (pounds or gallons)

(d) Number of treatments to be made this year __________

(e) Total amount of each chemical to be applied in all treatments ______________________________ (pounds or gallons)

15. Proposed date or dates of treatment ______________________
(Local Fish Commission Waterways Patrolman MUST be contacted prior to treatment.)

16. Additional remarks or information ______________________
____

17. Have all other riparian users, both in the vicinity of the treatment area and downstream who may be required to restrict their usages as a result of this treatment:

(a) Approved your plans? Yes ____ No ____

(b) Agreed to restrictions? Yes ____ No ____

18. The applicant: (a) Certifies the truth of the above statements; (b) Agrees to employ the listed chemicals in conformance with the manufacturer's specifications and with all the conditions of the permit; (c) Is responsible for all damages incurred by the chemicals used.

19. Applicant's signature ____________________

Date ____________________

20. Witness' signature ____________________

Date ____________________

FOR REVIEWER'S USE ONLY

APPLICATION AND PERMIT NO. ____________

Reviewer's Action:

Agency *Reviewer* *Title* *Date* *Approve* *Disapprove*

Fish

Commission ____________________

Remarks ____________________

____

Environm.

Resources ____________________

Remarks ____________________

____

INSTRUCTIONS FOR PREPARING APPLICATION FOR USE OF AN ALGACIDE, HERBICIDE OR FISH CONTROL CHEMICAL IN WATERS OF THE COMMONWEALTH

I. To apply for a permit to use an algacide, herbicide or fish control chemical, the applicant must submit one Application Form, properly completed, *signed* and attested to the Benner Spring Fish Research Station, R.D. #1, Box 200-C, Bellefonte, Pennsylvania 16823

These forms may be obtained from the following agencies:

1. Regional Offices of the Pennsylvania Fish Commission or Pennsylvania Department of Environmental Resources.
2. Fish Commission County waterways patrolmen.
3. Pennsylvania Department of Agriculture district offices.
4. County agricultural extension agents offices.
5. Pennsylvania State Soil and Water Conservation district offices.
6. District foresters offices.
7. U.S.D.A., Soil Conservation Service county offices.

II. A separate application must be filed for each body of water to be treated. Only one application is required for waters receiving several treatments in any one year; however, the frequency of treatment and the total dosage must be clearly stated. Submission of a new application is required for each successive year for those water bodies requiring continuous year-to-year treatment.

III. The applicant must complete all items 1 through 20 on the application form as follows:

1. Enter the name, address and telephone number of the applicant.
2. Enter the person or organization conducting treatment if other than the owner.
3. Enter the official name of the water body to be treated as it is given on a U.S.G.S. topographic map. If water body has no official name, give local name.
4. State the location of the water body as to county, the correct municipality and nearest built-up area.
5. State the type of water body to be treated.

6. Enter all uses of the water body to be treated.
7. Indicate if public fishing is allowed.
8. State if the water has ever been stocked with fish by a State or Federal agency.
9. Indicate if there is a discharge or overflow of water from the water body and at what time of year.
10. State name of receiving stream.
11. Give the *total area* of the water body to be treated in *surface acres* and the *treatment area* if it is less than the total area. *It is extremely important that an accurate average depth figure be given.*
12. State the species of algae, plant (s) or fish to be controlled.
13. State the commercial name (s) of the control chemical (s).
14. (a and b) Give the dosage per treatment in pounds or gallons of each chemical to be used. The labels of most chemical products utilized as algacides, herbicides or fish control chemicals recommend dosages per *surface acre* or *acre foot*. State as listed in manual or on manufacturer's label.
    (c) Give the amount of chemical to be used in *one* treatment. If more than one treatment, also complete part (e).
    (d) State the number of treatments to be made this year.
    (e) State the total amount of each chemical to be used in *all* treatments.
15. Indicate as accurately as possible the proposed date (s) of treatment, and do not fail to notify the local Fish Commission waterways patrolman prior to treatment.
16. Give any additional pertinent remarks or information.
17. Give special attention to this item as *failure to do so* may result in *your liability for any damages caused.*
18. Applicant should read and thoroughly understand all three sections of this item.

19 and 20. Applicant and witness must *sign completed* application to make it valid.